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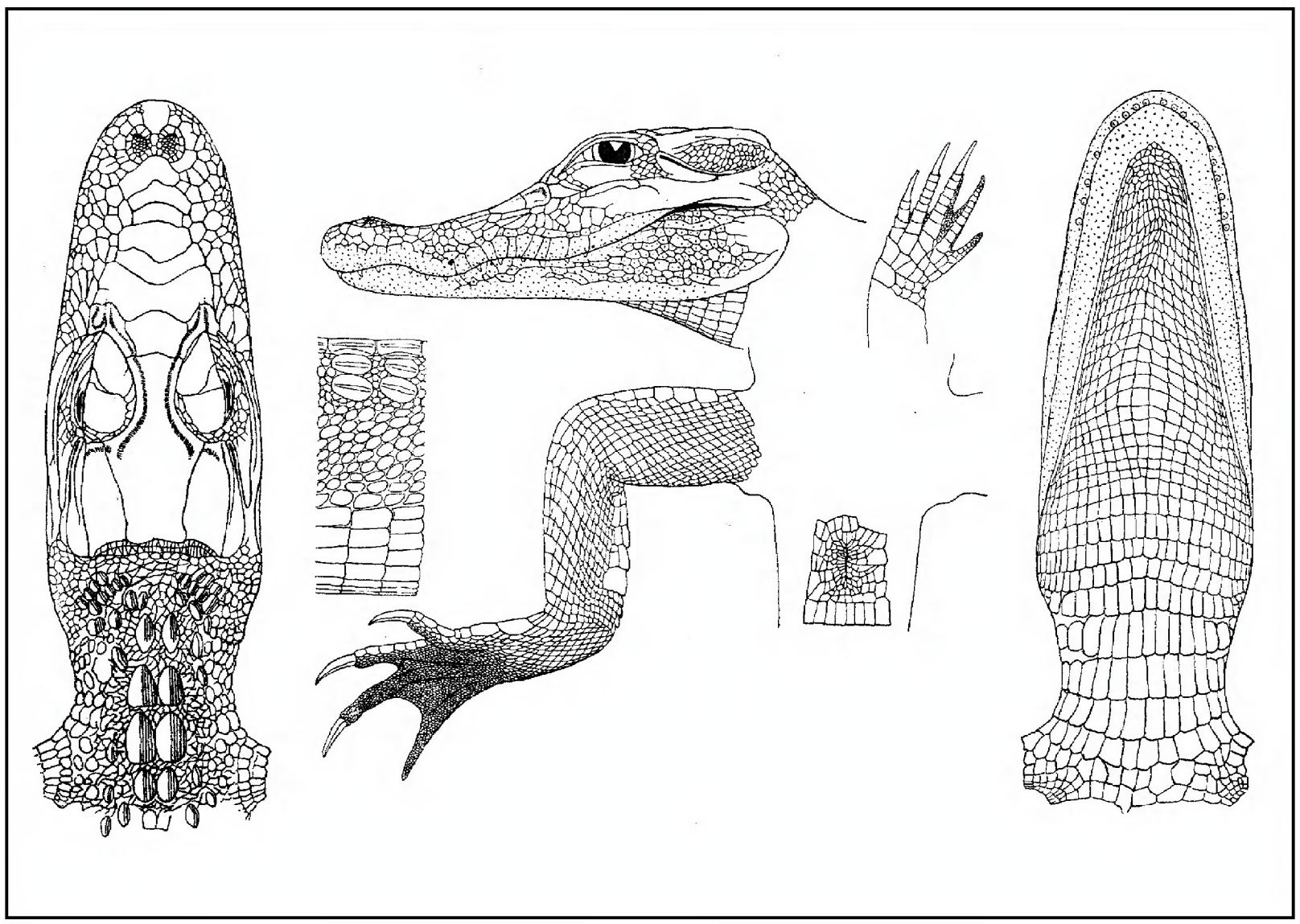

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The Pathophysiology of Clinically Pyramided Carapace Scutes in Tortoises (Testudinidae). . . . . Nicholas M. Lonce and Lee W. Morgan 201

2003 Snakes from Chihuahua and Adjacent States of Mexico . . . . . Julio A. Lemos-Espinal, David Chiszar, Hobart M. Smith and Guillermo Woolrich-Piña 206

Book Review: *The Gopher Tortoise: A Life History* by Patricia Sawyer Ashton and Ray E. Ashton, Jr. . . . . David S. Lee 213

HerPET-POURRI . . . . . Ellin Beltz 214

Herpetology 2004 217

Unofficial Minutes of the CHS Board Meeting, October 22, 2004 218

Advertisements 220

Cover: A young American alligator, *Alligator mississippiensis*, from Volusia, Florida. Drawings from "The Crocodilians, Lizards, and Snakes of North America" by Edward Drinker Cope, 1900, Part II of the Annual Report of the U.S. National Museum for the Year Ending June 30, 1898.

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The Pathophysiology of Clinically Pyramided Carapace Scutes in Tortoises (Testudinidae)

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Abstract

Pyramiding of carapace shell scutes is a common condition seen in captive chelonians. Unfortunately, there is a paucity of published information regarding this condition. Several theories exist as to the cause of this disorder including excess dietary protein, incorrect environmental parameters, genetic predisposition, and derangement of calcium homeostasis. The purpose of this paper is to review normal chelonian shell development and factors relating to the development of pyramidal shell scutes. Dietary recommendations for several species of tortoises are discussed to help combat the development of pyramidal carapace scutes.

Key Words: pyramiding, carapace, shell scutes, tortoises, nutrition, shell development

Introduction

The purpose of this article is to discuss the pathophysiology of grossly raised epidermal scutes in tortoises. In the United States, there are an estimated 2.5 to 15 million pet turtles (Orenstein, 2001). Unfortunately, an overwhelming number of those animals do not receive proper care, either through the owner's lack of knowledge, or sheer negligence. Tortoises have strict dietary requirements. For example, protein and calcium metabolism are extremely important aspects of chelonian health and improper dietary intake of these nutrients is often manifested as shell deformities. One such deformity is the "pyramiding" of the carapace scutes. This syndrome is characterized by the formation of raised, pyramid-shaped scutes on the carapace. Although shell pyramiding has most often been reported in captive chelonians, the syndrome has been noted in wild turtles. Jarchow (1992) noted pyramiding in wild tortoises. A 1996 study of freshwater aquatic turtles from Crisp County, Georgia, noted the occurrence of necrosis and pyramiding on the carapace in *Pseudemys concinna* and *Trachemys scripta* (Lovich et al., 1996). There is comparatively little literature on this malady, and most reports are anecdotal in nature.

Normal shell development

The chelonian shell is a dynamic tissue. Frye (1991) describes the turtle shell as a thick mantle, heavily keratinized and overlying a stratum germinativum, with these layers covering a bony plate. There are "horny" scutes formed by the epidermis below, which is adequately vascularized and innervated (Mlynarski and Wermuth, 1975, p. 76). The makeup of these horny scutes is similar to that of the human fingernail, consisting of keratinized cells (keratinocytes) (Latkowski and Freedberg, 1999). This outermost layer, the stratum corneum, is what one sees when observing the shell (ibid.) Frenkel and Gillespie (1976) stated in their study of kookaburra beak composition, that the overall composition of that particular bird beak is similar to that of turtle scute proteins, which are composed of keratin (Orenstein, 2001; Miller and Harley, 1999; Alderton, 1988). Keratin is a protein, described as a mix of keratin fibers and keratohyaline (Seeley et al., 2000). Of the two major types of keratin, α keratin and the harder β keratin, tortoise shells are composed of only the latter (Orenstein, 2001). Under the individual scutes are specialized cells, known as Malpighian cells, that manufacture the keratin for deposition on the shell (Alibardi and Thompson, 1999). The shell scutes enlarge by a process in which the Malpighian cells deposit keratin to the base of the existing scute (ibid.) A new scute is thus added with each passing growth season, the new one larger than the last to compensate for the growing bony shell beneath.

Latkowski and Freedberg (1999) describe the process of keratinization, which involves the maturing of keratinocytes as they migrate from the basal layer to the stratum corneum. These cells are packed with protein granules, which are used in construction of the cornified cell envelope. The keratinocyte cell membrane first becomes more permeable to ions such as calcium. The movement of calcium then activates the conversion of profilaggrin to filaggrin, the breakdown of keratohyaline granules and the activation of enzymes (TGase). Macrofibrils are formed from the aggregation of keratin filaments and organization of filaggrin, within the inner stratum corneum. These filaments are stabilized by the formation of intermolecular disulfide bonds, in order to prepare for the remodeling of cytoplasm in the outer stratum corneum. Filaggrin then degrades to amino acids, later modified to form other molecules. The nucleus degenerates, and the cells then flatten. Once this happens, the large keratin macromolecules lie parallel with the keratinocyte plasma membrane, and the enzyme TGase catalyzes cross-links with the various proteins to the cell membrane.

Upon completion of the keratinization process, the cornified envelope has formed. This cornified envelope is what protects the epidermis from the elements, with an insoluble layer of protein that is covalently linked to the plasma membrane of the keratinocyte. A comparatively thin lipid layer overlays the protein. Many other molecules are involved in this process. Because the keratinocytes that compose the shell are hardened by the β keratin, they do not desquamate (Seeley et al., 2000), and are removed only by wear the animal experiences.

Alibardi and Thompson (1999) examined the epidermal differentiation process closely in the embryonic stage of the species *Emydura macquarii*. They reported a similar sequence of events as described above in lesser detail, also suggesting the importance of calcium to combine with organic molecules within the β keratinocytes to harden the tissue (resulting in its hardness, in contrast to α keratin).

Underneath the scutes are the bones that give tortoise shells their strength. Skeletal anatomy is beyond the scope of this discussion, but in general, the carapace is made up of the vertebrals (bones running down the dorsal midline), the costals/pleurals (bones adjacently lateral to the vertebrals, roughly over the ribs), and the peripherals, outlining the shell. The scutes do not correspond directly to bone underneath them (Orenstein, 2001; McArthur, 1996). The bones that comprise the shell are a combination of dermal and endochondral bone. The dermal bone components develop first after the scutes, during the embryonic stage in the egg. Then the ribs (still made of cartilage) invade these plates and ossify into the complete shell. The peripheral scutes and bones form around the costals and vertebrals (Orenstein, 2001; McArthur, 1996). The bones that exhibit excessive shell pyramiding most prominently are the vertebrals and costals. After hatching, and for the rest of the animal's life, these bones grow larger from the outer edge of the bone (Wiesner and Iben, 2003). The bone itself is constructed of calcium and phosphorus in an organic matrix. The process by which bone is laid down and maintained is a dynamic one that never ends and thus is sensitive to nutritional and metabolic imbalances (Favus, 1993; Seeley et al., 2000). The areas of growth in the carapace bones are known as growth gaps. These are cartilage (especially in fast growing juveniles) that is gradually ossified and widens the gap, allowing for larger shell size with growth (Wiesner and Iben, 2003). A study done on three-toed box turtles (Magliola, 1984) showed the developmental effects of estrogen on shell formation and reflects the importance of mineral homeostasis in chelonians.

Popular folklore states that one may count the "growth rings" on any chelonian that displays visible ridges in the scutes and deduce the age with relative accuracy. The scutes are usually deposited on an annual basis, reflecting each season when the animal is able find food in abundance. The growth rings (annuli) are arranged concentrically around the areola of each individual scute. The wider the annuli, the more the chelonian has grown in that particular growth season, before a period of drastically slowed, or complete cessation of growth (Orenstein, 2001). Although this is not always a reliable indicator of age, it does reflect upon the animal's lifestyle. Orenstein (2001, p. 5) compares a medium sized Bell's hinge-back tortoise (*Kinixys belliana*), with relatively few, wide annuli that suggest rapid growth over a short period of time, to a diminutive spider tortoise (*Pyxis arachnoides*), which is more likely to have many closely packed rings, indicating many seasons of growth to reach that size. In captivity, however, those annuli may be much wider than those of wild counterparts, due to the constant abundance of food.

Pyramiding of shell scutes

The precise cause and mechanism for the formation of pyramided shell scutes has not been well researched, with few studies having been conducted. A wide range of disorders can affect shell health in chelonians. Developmental, environmental, pathological, and nutritional abnormalities can all play a part in the malformation of the chelonian shell. Shell protein composition is an important sentinel in systemic disease diagnosis, according to one study in which *Gopherus agassizii* scute proteins were isolated and compared to other β keratin sources (e.g., domestic chicken feather, and *Alligator mississippiensis* scale) (Homer et al., 2001). Gross enlargement or pyramiding of shell scutes is often a clinical manifestation of an underlying metabolic pathology. Pyramiding shell scutes have been noted in hatchling tortoises fed diets deficient in calcium or diets of high protein pet foods (Donoghue and Langenberg, 1996; Highfield, 2002). Excess caloric intake, insufficient vitamin D, excesses or deficiencies of vitamins, lack of ultraviolet light, and the consumption of fermented ingredients may also result in pyramiding (Stearns, 1989). A photograph in Mader's *Reptile Medicine and Surgery* illustrates the result of improper diet on a "spur-thighed" tortoise (*Geochelone sulcata*). A healthy adult is pictured next to a three-year old juvenile with profound pyramiding of the shell scutes (Donoghue and Langenberg, 1996, p. 161). Boyer (1996) suggests that tortoises are the most likely victims, with possible causes including excess dietary protein, excessively rapid growth, metabolic bone disease, excess or deficiency in vitamins or minerals, or even species predisposition. Because the cause may be multifactorial in nature, pyramiding of the shell scutes may indicate more severe, subclinical metabolic perturbations. Often, animals with clinically raised shell scutes also have other metabolic problems, such as secondary hyperparathyroidism, articular/visceral gout, and problems with the liver or kidneys (McArthur, 1996).

Excessive dietary protein has most often been implicated as the cause of pyramiding shell scutes. Highfield (1990) suggests that an herbivorous tortoise should be fed a diet no more than 4% in total protein and that tortoises fed commercial dog food, which is high in protein, will exhibit pyramiding (Highfield, 1990, 2002). Frye (1991) comments that the abnormal appearance of "raised, almost conical" shell plates is believed to be at least partially attributed to a high protein diet. Stearns (1989) reports on hatchling *G. sulcata* that were kept on a substrate of alfalfa pellets, which are high in dietary protein. These tortoises exhibited pyramiding despite a low protein diet and it was hypothesized that the hatchlings were ingesting the substrate. A later clutch, raised on either newspaper or hay substrates, did not exhibit pyramiding to the same degree as did the first clutch. The husbandry was the same for the two successive clutches (Stearns, 1989). A captive tortoise that was fed a commercial dog food as the principle component of its diet was observed to have severe pyramiding of the shell scutes (Martin Rosenberg, Case Western Reserve University, pers. com.) It may be that pyramiding of the shell scutes is an adaptive mechanism to store excess protein by-products that overwhelm the excretory system.

Innis (1994) reports on a colony of radiated tortoises maintained indoors for the first two years of life. The tortoises were fed an 18% proteim diet and the colony exhibited a high percentage of pyramidal shell scutes. However, once the animals were allowed outside at two years of age, the incidence of pyramiding decreased, although the same diet was fed. This suggests that natural ultraviolet light may be important in proper scute development.

A recent Austrian study experimented with different crude protein (CP) levels with varying environmental humidity and gauged its effects on shell formation in *G. sulcata* neonates. Fifty hatchlings were divided into five groups, labeled A–E. Groups B, C and D were fed the same diet (~19% CP on a dry matter basis) but the groups were kept in increasingly humid conditions. Group A was fed the lowest protein diet (~14% CP) but kept in the most arid environment (24.3–57.8% relative humidity). The final group, E, was kept in the most humid terrarium (45–99% relative humidity) and fed the highest protein diet (30.7% CP). All other environmental parameters were kept constant, in identical terraria. At the end of the 150-day feeding trial, the researchers found that the tortoises in group B (kept in the driest terrarium and fed a 19% CP diet) had the greatest pyramidal growth, with animals in C having less growth (kept more humid, ~30.6-74.8% relative humidity), and the tortoises in group D having least growth of all groups studied (kept in 47.9-99% relative humidity). The animals in group A had higher shell humps than the groups C through E, even though they were fed the lowest protein. Group E's tortoises exhibited slightly higher shell growth than that of D, but according to the article's statistical analysis, the difference was not significant. The researchers concluded from this study that humidity appeared to have a primary role in tortoise shell development, with secondary importance given to protein levels in the diet. The higher humidity led to smoother shell growth while the drier terraria yielded lumpier shells (Wiesner and Iben, 2003).

Genetic predisposition may play a role in the development of pyramidal shell scutes. Star tortoises, *G. elegans*, for instance, may have pyramided shell scutes as part of their normal anatomy (Bartlett and Bartlett, 1996). Stearns (1989) notes that *G. sulcata* hatchlings from a particular clutch may show pyramiding, while other members of the same clutch do not, even though they are kept in identical conditions. Moreover, some species may be more prone to the disorder than others. *Testudo* species, for instance, appear less likely than other tortoises to exhibit pyramiding (Stearns, 1989).

Derangement in calcium homeostasis has been implicated in the pathophysiology of raised shell scutes. While calcium deficiency may result in softened shell scutes due to its importance in hardening the β keratin (Alibardi and Thompson, 1999), excessive dietary calcium may cause mineralization of liver and other soft tissue. In one case, a yellow-footed tortoise (*G. denticulata*) was fed commercial cat and dog food, raw liver, and supplements of excess vitamin A and D (Frye, 1991). On initial examination, this animal exhibited pyramided shell scutes. Extensive calcification of the soft tissues was observed upon necropsy, particularly in the pulmonary system and its conducting passages. Calcium phosphate in the form of hydroxyapatite was found. The liver of a leopard tortoise (*G. pardalis*) with pyramiding shell scutes was examined in another study (Frye, 1991). Histologic sections of the hepatocellular parenchyma yielded radiodense tissue. Lesions of an early stage showed wisps of lightly mineralized material while the more chronic regions were found to have true bone formed, with osteocytes and primitive Haversian systems. The bladder was hardened to the point of not collapsing on applied digital pressure.

However, a study by Stancel et al. (1998) showed that while over-supplementation of calcium and phosphorus decreased growth in red-eared sliders, it did not induce pyramiding. Hatchling red-eared sliders were fed diets supplemented with dietary Ca and/or P at levels ranging from 1.16-2.95% Ca and 0.92-2.56% P during their most active growth phase (12–35 weeks). Pyramiding was not induced in any of the test subjects, and the authors concluded that excess dietary Ca or P was not important in the development of pyramidal shell scutes.

The underlying bone is also important to shell physiology. The overlying scutes do not exactly match the individual bones, creating a structural advantage like that conferred by the different layers in a sheet of plywood (Orenstein, 2001). Thus, diseases that affect the bone may ultimately affect the shell. In accompaniment with metabolic bone disease, the shell bones may grow thin, accompanied by an increasing the amount of trabecular bone formation, in an attempt to buttress the bone that is weakening from lack of available calcium (Latkowski and Freedberg, 1999). This may contribute to the raised scute appearance, and a cross section of a visibly lumpy shell may display an infusion of grossly enlarged trabeculae (Highfield, 2002; McArthur, 1996). Highfield (2002) proposes that excess dietary protein can interfere with calcium metabolism.

A possible, though untested, explanation was suggested by Wiesner and Iben in their 2003 study on *G. sulcata*. They put forth the notion that when the tortoises in their study were kept in arid conditions, the dehydration the animals experienced might have had deleterious effects in the rapidly growing shells. The growing gap area comprised of cartilage (where new bone would be laid down) could experience drops in intra- and extracellular pressure on the soft tissue. Chronic dehydration would lead to this collapsed tissue being permanently ossified, creating a "valley" between the scutes. Successive shell growth would create new valleys and subsequently higher humps (Wiesner and Iben, 2003). Though not actually studied, this hypothesis could prove to be a valuable starting point for those interesting in directly researching the precise mechanism for pyramidal growth. A private tortoise breeder in Austria provided the motivation for the study in that country, by observing how hatchlings raised in humid conditions exhibited smoother shells than those who were not. A rationale for this may be found by looking at the habits of these animals and the habitats from which they hail. In the grasslands where *G. sulcata* naturally occur, the hatchlings are vulnerable to predation by a wide range of predators. They spend a large

amount of time hiding in the dense vegetation, from which they also feed. And the relative humidity in this microhabitat (similar in concept to that of burrowing tortoises) is much higher than the general habitat. So, the researchers reason when the juvenile tortoises are exposed to an abundance of feed it is in a humid environment. During dry spells, there is very little vegetation available aside from dried plants of high fiber content, so little growth occurs (Wiesner and Iben, 2003). Though this particular hypothesis has not been tested, the artificial conditions under which this study on captive tortoises and humidity was performed seem to support this reasoning.

Diet

A wide variety of selected plants is generally recommended as the best model for ensuring chelonian health (along with proper environmental conditions). It may be next to impossible to procure the exact flora and fauna from a particular species' natural habitat, especially for exotic tortoises. In the past, literature regarding captive tortoise diets was anecdotal at best and often led to some of the problems addressed in this discussion. Private hobbyists and breeders have generated a pool of information on tortoise diets previously unavailable in the recent past. Though not thoroughly researched, these trial and error experiences by amateur and commercial herpetoculturalists have laid down a foundation for anyone needing a starting point in formulating the best diet for their captive tortoises.

In addition to refereed literature, popular literature published by amateur and professional tortoise breeders in magazines and how-to books are a valuable resource for the novice tortoise keeper. The Internet has also provided a medium by which people can access information on dietary and husbandry needs of tortoises, however, caution should used since material may not be reviewed by experts prior to be posted on-line. Web-sites such as those hosted by Association of Reptile and Amphibian Veterinarians (www.arav.org) and the World Chelonian Trust (www.chelonia.org) are two reliable sources. In the succeeding paragraphs, the following suggestions for diets for different groups of tortoises have been drawn from the sources mentioned above.

For grassland tortoises of the genus *Geochelone*, most commonly the leopard (*G. p. pardalis*, *G. p. babcocki*), African spurred (*G. sulcata*), radiated (*G. radiata*), Chaco (*G. chilensis*), and star (*G. elegans*), the bulk of the diet should consist predominantly of high fiber roughage, most readily in the form of high quality grasses (timothy, Bermuda, orchard) and weeds (dandelion, grape leaves, mulberry leaves), provided they are clean and free from chemical additives of any kind (pesticides, fertilizers). Timothy and alfalfa, fresh or as hay, can be given as well. Popular literature suggests that rye should be avoided due to possible viral transmission. Despite the lack of research to bolster this claim, it would seem wise to avoid this plant. Some other items that can be included are succulents like agave, and cacti (*Opuntia* spp.) Small amounts of certain fruits are acceptable as occasional treats. Examples might be blueberries, blackberries, grapes, pumpkin, squash, and zucchini. It should be noted that the tough fibrous vegetation should comprise a vast majority of the diet. American *Gopherus* species also fare well on this high fiber diet of apparently unpalatable grasses and succulents (Bartlett and Bartlett, 1996; Ernst et al., 1994, Highfield, 2002).

Also commonly kept are the tortoises of the genus *Testudo*, which include the Mediterranean spur-thighed (*T. graeca*, *T. ibera*), Hermann's (*T. hermanni* ssp.), Egyptian (*T. kleinmanni*), marginated (*T. marginata*), and Russian (*T. horsfieldi*). These animals generally hail from a dry, scrubby terrain, preferring weedy matter to grass. Some suggested plants to choose from are untreated rose petals, petunia (leaves and flowers), clover (leaves and flowers), chickweed (leaves), nasturtium (leaves and flowers), pansies (leaves and flowers), wallflowers (leaves and flowers), plantains (leaves), dandelion (flowers and leaves), hairy bittercress (leaves), sow thistles, mustard greens, raddichio and sorrel (Bartlett and Bartlett, 1996, Highfield, 2002). Most other species of tortoise will accept these foods as well.

Some forest tortoises, like red-footed (*G. carbonaria*), yellow-footed (*G. denticulata*), Burmese mountain (*Manouria e. emys*, *M. e. phayeri*), and elongated (*Indotestudo elongata*) require more protein in their diet as well as fruit and greens. The protein can come in the form of trout or catfish chow, or any low fat pellet, and pesticide-free invertebrate prey. An important caveat to take into consideration is that they require more protein than grassland tortoises (in general) but it should be given sparingly. Some relished fruits are plums, squash, tomatoes, apples and pears (Bartlett and Bartlett, 1996; Highfield, 2002).

Tortoises of the genus *Kinixys* include Bell's (*K. b. belliana*, *K. b. spekii*), Home's (*K. homeana*), and serrated (*K. erosa*). These should be fed the aforementioned fruits and vegetables, as well as animal protein: snails, millipedes, slugs and earthworms (Bartlett and Bartlett, 1996, Highfield, 2002). The items mentioned here do not comprise an exclusive list, as there exist many more plants and animals which would be excellent fare for captive chelonians. Researching the acceptability of these items for potential toxicity and nutritive value is absolutely essential. Feeding a wide variety of food substances, along with careful supplementation, will ensure the best nutrition. A good supplement can be sprinkled on every other feeding for young animals, every other week for adults, and every day for reproducing females (Alderton, 1997). Retail outlets catering to reptile needs, herpetological expos, and mail order businesses can provide a tortoise keeper with the most popular supplements on the market.

Many factors, including diet may be responsible in the formation of raised shell scutes. Those that care for tortoises should have a basic understanding of the pathophysiology of this disease in order to help avoid its occurrence. More controlled studies are needed to address the causative nature of this issue.

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2003 Snakes from Chihuahua and Adjacent States of Mexico

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Abstract

Forty snake taxa are reported from Chihuahua, Sonora and Zacatecas. Of special interest are *Arizona elegans expolita*, 3rd record from Zacatecas; *Bogertophis subocularis amplinotus*, new to Chihuahua; *Crotalus molossus nigrescens*, redefinition; *Dryadophis cliftoni*, new to Chihuahua; *Drymobius margaritiferus fistulosus*, new to Chihuahua; *Hypsiglena torquata*, rank elevation, new to Chihuahua and monotypy; *Hypsiglena ochrorhyncha chlorophaea*, species name changed; *Leptotyphlops dugesii*, rank elevation; *Masticophis bilineatus*, first record midstate western border; *Masticophis mentovarius striolatus*, juvenile pattern; *Pituophis d. deppei*, 2nd precise record in Chihuahua; *Procinura aemula*, known specimens doubled; *Rhinocheilus antonii*, rank elevation and range extension in Sonora; *Senticolis triaspis intermedia*, range extension in Sonora; *Tantilla yaquia*, 2nd known specimen from Chihuahua; *Trimorphodon tau*, range extension in Sonora; and *Tropidodipsas* sp. nov., related to *T. annulifera*.

Arizona elegans expolita Klauber. 11290, km 111, San Luis-Zacatecas, Zacatecas.

This species and subspecies has been reported in Zacatecas only from 2 mi NW Victor Rosales (Fleet and Dixon, 1971) and 21 mi SW San Loreto, San Luis Potosí (Williams et al., 1961).

Bogertophis subocularis subocularis (Brown). 11657, exit SE Ojinaga (29°34′3.2″N, 104°28′7.5″W), 910 m; 11658, customs office at El Pegüis (29°32′3.7″N, 104°47′38.8″W), 1033 m; 11659, railway junct El Morrión-Ojinaga (29°4′45.0″N, 105°35′3.7″W), 1357 m.

All have paired black stripes of variable width (from two and two half-scale rows to two half-scale rows) on neck and fore part of body; the stripes are relatively short, continuous at most for only about one fourth of the SVL. The vertebral length of all dark blotches on the body, and with one exception on the tail, is distinctly less than that of the interspaces and in some cases almost one-fourth less.

The subspecies is well known within the area represented by these specimens (Webb, 1990; Lemos-Espinal, Smith and Chiszar, 2000; Lemos-Espinal et al., 2002).

Bogertophis subocularis amplinotus Webb. 11859, betw Escalón and Carrillo (26°43′47.0″N, 104°18′29.1″W), 1100 m.

Although Webb (1990) recorded an "intergrade" between *B. s. subocularis* and *B. s. amplinotus* from 13.3 rd mi E Escalón, very close to the present record, our specimen is typical of the latter subspecies and as such we regard it as the first recorded for the state.

The paired black stripes on neck and anterior third of the body are continuous, uniformly two and two half-scale rows wide for three head lengths on body, and thereafter they vary from that width to one and two half-scale rows. The vertebral length of the dark dorsal blotches is equal to or greater than the vertebral length of the light interspaces on the posterior three-fifths of the body.

Crotalus atrox Baird and Girard. 11557, Unamichi, Sonora (30°40′8.1″N, 109°58′56.1″W), 990 m; 11605-6, 11863, 11923-4, betw Escalón and Carrillo (25°43′47.0″N, 104°18′29.1″W), 1100 m; 11613-4, 11925, Ojinaga (29°34′3.2″N, 104°28′7.5″W), 910 m; 11661, Coyame (29°27′48.2″N, 106°5′1.2″W), 1270 m; 11683, La Mula (29°8′22.7″N, 104°24′26.0″W), 1100 m; 11715, SW Ojinaga (29°34′3.2″N, 104°28′7.5″W), 910 m.

All of these specimens are from within the known range of the species. Two from the sand dunes between Escalón and Carrillo are exceptionally light, the blotches light-centered, and the markings on the head are scarcely visible; others from the same locality is normal in pigmentation; in one the light spaces between the dark rings on the tail are gray. The specimen from Sonora is exceptionally dark, but the markings on the head are prominent.

One from Ojinaga (11925) closely resembles the pattern of the coastal phase of *Crotalus r. ruber* (Klauber, 1972: 84), even lacking the light spots in the centers of the dorsal blotches. However, other diagnostic character-states conform with those of *C. atrox*: a minimum of three scales in a row between the supraoculars (vs five or more), first infralabial not divided (vs divided), and 25 scale rows (vs usually 29). This pattern variant in *C. atrox* perhaps reflects its close relationship to *C. ruber*.

Crotalus basiliscus (Cope). 11468, La Ciénega (27°27′27.5″N, 108°34′50.9″W), 469 m; 11527, Milpillas (27°11′29.2″N, 108°38′38.2″W), 1250 m; 11685, Güicorichi (27°38′6.5″N, 108°28′19.0″W), 1500 m; 11686, Santa Ana (27°38′22.7″N, 108°32′36.1″W), 1500 m; 11921, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m.

Specimens 11527 and 11921 are huge males, with the brown tail that usually distinguishes this species from *C. molossus*. Another distinctive feature of this species, as compared with

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C. molossus, is the change in shape of the rhomboidal blotches anteriorly to relatively narrow, more numerous crossbands posteriorly. One specimen (11686, a skin in alcohol with the tail complete and the entire head and neck present but detached, TTL about 750 mm) is exceptional; the rear of the body and the tail appear jet black. However, the underside of the tail is much lighter than the dorsal surface, whereas in *C. molossus* the tail is equally jet black both above and below.

Crotalus lepidus klauberi Gloyd. 11607, General Trias (28°25′5.9″N, 106°25′55.4″W), 1516 m.

The pattern in this specimen has little dark marking in the spaces between the symmetrical black rings, and is thus typical of this subspecies.

Crotalus molossus nigrescens Gloyd. 11541, km 18, Chihuahua-Namiquipa (29°5′28.7″N, 106°28′51.4″W), 1743 m; 11922, Maguarichi (27°51′29.2″N, 107°59′41.6″W), 1667 m.

There is a broad area of what has been regarded as intergradation between this subspecies and *C. m. molossus* in the tonguelike extension of the range of partially *nigrescens*-like specimens northward from Durango into the mountains of western Chihuahua, as pointed out by Price (1980). That extension conforms climatically and topographically with the main range of *nigrescens* on the plateau southward from Durango.

The primary differences between the two subspecies are in (1) pattern and (2) number of scale rows and ventrals. These two features differ geographically, in the tonguelike area, in where they shift from one character state to the other. The pattern change occurs farther north, to within ~100 km of the U.S. border, than the scalation change (northern Durango).

It seems likely that some introgression of the scalation characters of *C. m. molossus* has occurred in the Chihuahua projection from the main range of *C. m. nigrescens*, while the pattern character of the latter remained intact. Where exactly the transition from one color/pattern type to the other occurs, if indeed it does, remains to be clarified.

The Chihuahua populations appear basically to be derived from those of typical *C. m. nigrescens*; they have received some introgressive effect of the surrounding *C. m. molossus*, but their evolutionary derivation is best reflected by consideration of them as *C. m. nigrescens.* It is not an example of typical intergradation.

The present specimens conform with the characters of other high-mountain Chihuahua examples of the species. The dark dorsal coloration of 11541 completely obscures the dorsal blotches on the posterior two tail-lengths of the body. The head is more or less uniform brown above. In 11922 there are extensive dark markings on a somewhat lighter ground color of the head, but the body blotches are but dimly visible throughout the length of the body. In both the tail is jet black above and below, sharply contrasting with the color of the venter. These features characterize *C. m. nigrescens,* and determine taxonomic assignment to that subspecies.. The introgressive effect of *C. m. molossus* is evidences in low scale row (27, 29) and ventral counts (181, 189).

Crotalus pricei pricei Van Denburgh. 11682, Pitorreal (27°38′6.5″N. 107°47′45.3″W), 2310 m.

The adult has the typical twin spots of the species.

Crotalus scutulatus scutulatus (Kennicott). 11587, km 13 Chihuahua-Namiquipa (29°4′30.8″N, 106°26′42.9″W), 1700 m.

This is the westernmost locality of record for the species in Chihuahua. The nearest is for the vicinity of Balleza (26°55′48.3″N, 106°20′57.3″W), as reported by Lemos-Espinal, Smith and Chiszar (2000).

Like *C. scutulatus*, *C. molossus* has a minimum of two scales in a row between the supraoculars, but the latter has one pair of internasals, one pair of prefrontals, and the tail has no or very dim dark bands. In 11587 there are more numerous scales in the area anterior to the supraoculars, and the tail has prominent black rings separated by light gray interspaces.

Crotalus willardi silus Klauber. 11687-8, 11838, Güicorichi (27°38′6.5″N, 108°28′19.0″W), 1500 m.

These specimens appear typical.

Dryadophis cliftoni Hardy. 11694-5, Guamuchilito, nr Agua Salada (27°23′21.9″N, 108°29′5.5″W), 510 m.

These two specimens constitute a first record for Chihuahua. Their description has been submitted elsewhere (Lemos-Espinal, Chiszar and Smith, 2004a).

Drymarchon melanurus rubidus Smith. 11379, Vado de Cuba (27°25′1.6″N, 108°32′48.8″W), 430 m; 10459-60, 11491-4, 11522, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m.

All are uniformly jet black above and on the ventral surface of the tail as well as the posterior fifth of the venter, except in the smallest specimen (11494, 663 mm TTL). In that specimen the lateral edges of some transverse rows of dorsals are light, forming interrupted light bands separating totally dark areas of about the same size. This pattern is intermediate between the solid pattern of adults and the spotted pattern of juveniles. The same specimen was caught with a partially swallowed *Thamnophis cyrtopsis cyclides*.

Drymobius margaritiferus fistulosus Smith. 11693, Guamuchilito, nr Agua Salada (27°23′21.9″N, 108°29′5.5″W), 510 m; 11720, Chínipas (27°23′29.9″N, 108°32′9.7″W), 469 m.

Both specimens have the typical black coloration with a bright white dot in the center of each scale. The posterolateral edges of the ventrals and subcaudals are black. The dorsal and lateral surfaces of the head are black, excluding parts of the supralabials.

The present records are about 325 km north of the northernmost reported by Hardy and McDiarmid (1969) for Sinaloa. The records in Bogert and Oliver (1945: 407) for, presumably (not stated), near Guirocoba, Sonora, and of Hale (1989) for Río Cuchijaqui, 7 mi E Álamos, Sonora, both at about the same latitude as the present records, are the only others north of southern Sinaloa.

Heterodon kennerlyi Kennicott. 11670, head only, betw

Aldama and El Morrión (29°4′45.0″N, 105°35′3.7″W), 1352 m.

There are 5 azygous scales, and 1-2 loreals, conformant with the diagnostic character states of this species. The locality is well within its known range.

Hypsiglena torquata (Günther). 11466-7, 11691, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m; 11692, Güicorichi (27°25′0.0″N, 108°35′14.5″W), 600 m.

All four specimens exhibit the unique white collar of this taxon (Dixon and Dean, 1986), and in three the postocular dark line is widely separated from the nuchal blotch, correlated with the presence of the white collar. The exception is a somewhat dehydrated hatchling with a damaged head; it is uncertain whether the postocular dark streak reaches the nuchal blotch or not. Its white nuchal collar is apparently about as long as broad, and may not extend onto the lower sides of the neck as it does in the others.

The white collar in this series is constant, and so is its absence in the five specimens of *H. ochrorhyncha chlorophaea* here reported. The localities represented by the latter are north of Chínipas, and at a mostly higher altitude, although one is very near the latter, at Milpillas. Collared specimens occur southward. These taxa may intergrade as subspecies, as concluded by Tanner (1985), but he provided no conclusive evidence, and our evidence does not support that concept. The Milpillas and Chínipas specimens show no evidence of intermediacy. Tanner referred all of his Chihuahua material to *H. t. chlorophaea* and *H. t. texana* (= *H. o. janii*); he saw none from their localities with a white collar or from the extreme southwestern area near Chínipas. Bogert and Oliver (1945) reported two from Guirocoba, Sonora, with a light neck collar, and four lacking it from Guirocoba, one from Álamos.

Dixon and Dean (1986) suggested that these two taxa may represent different species. Our material supports that suggestion, which we follow, on the basis of pattern alone. The supposed average difference in ventral counts seems not to be valid distinguishing character-states (supposedly less than 232 in *H. torquata*, 232 or more in *H. o. chlorophaea*). They are 233+ , 239 and 244 in our *H. torquata*, and 228, 229, 240 and 241 in our *H. o. chlorophaea*. Dixon (1986) suggested that hybridization may occur between these two species in southeastern Sonora and southwestern Chihuahua. No population with intermediate patterns is known. Species can coexist with only pattern differences, as in *Sceloporus pictus*/*S. megalepidurus* and others.

This is another taxon to be added to the herpetofaunal list of Chihuahua.

Hypsiglena ochrorhyncha chlorophaea Cope. 11611, Milpillas (27°11′29.2″N, 108°38′38.2″W), 1250 m; 11634, 11866, betw Basaseachi and Maicoba (28°23′0.1″N, 108°50′57.6″W), 1603 m; 11867, bridge at entrance to Moris (28°9′38.3″N, 108°29′50.5″W), 774 m; 11868, Güisamopa, Sonora (28°38′37.7″N, 109°6′34.1″W), 671 m.

None of these specimens exhibit a white collar; all but one (11868) have a median extension forward from the nuchal blotch to or nearly to the parietals. In all the postocular dark streak reaches the nuchal blotch, or (11611) is very narrowly separated from it. (See account for *H. torquata*.)

Hypsiglena ochrorhyncha janii (Dugès). 11609, 11964, betw Escalón and Carrillo (26°43′47.0″N, 104°18′29.1″W), 1100 m; 11666, km 22 betw El Morrión and Ojinaga (29°7′24.4″N, 105°13′9.0″W), 1163 m.

The best criterion of which we are aware, other than geographic distribution, for distinguishing this subspecies from *H. o. chlorophaea* is the separation of the otherwise single nuchal blotch into two, bilateral blotches. The present specimens conform with that distinction.

Lampropeltis knoblochi Taylor. W/o number, 6.5 km W Cuiteco (27°29′28.0″N, 107°55′35.7″W), 2268 m.

There are a large number of dorsal blotches—71 on body, 18 on tail. None are fused, as opposed to the considerable fusion in the one previously reported by Lemos-Espinal, Chiszar and Smith (2003), with 38–48. The nuchal blotch is 9 scales long, the next 5, followed by 4, and the rest mostly 3 or parts of 3, all including their black borders. The black borders are fused medially, splitting the red area, in a few at the rear of the body, and the posterior ten on the tail. The black borders extend no lower than the 5th scale row over most of the body, the 3rd posteriorly. There is a light spot on the posterior part of the frontal, as apparently in all others of the species.

Leptophis diplotropis (Günther). 11470, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m.

The keels on the scales of the paravertebral rows are accentuated by a narrow black line. All scales on the tail are smooth, and the black lines are missing. The ventrals are 182, the subcaudals 143+ (perhaps about 5 missing).

The comparison of ventral and subcaudal scale counts in Tehuantepec vs Sonora/Chihuahua material (Oliver, 1948), augmented by Tanner's (1985) and the present data, makes it plain that the highest mainland counts occur at the two extremes of the range of the species, whereas they are lower in the middle (Sinaloa, Hardy and McDiarmid, 1969). High counts occur also in the Tres Marias Islands (Zweifel, 1960). It does not seem likely that this pattern of geographic variation in ventral counts has an environmental origin; it is not consistently clinal. Its evolutionary origin would be of considerable interest. Subspecific differentiation of the Tres Masrias population is not evident, as concluded by Oliver (1948).

Leptotyphlops dugesii (Bocourt). 11563, Milpillas (27°11′29.2″N, 108°38′38.2″W), 1250 m; 11706, Barrio de la Loma, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m; 11927, Ejido San Antonio, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m.

All specimens have 12 caudal scale rows; the head scales are normal for the species.

The adjacent species *L. humilis* has 10 caudal scale rows, whereas *L. dugesii*, formerly regarded as a subspecies of *L. humilis*, has 12. There is a 230 km hiatus between the known geographic ranges of *L. h. segregus* in Arizona (none are known in Sonora), and *L. dugesii* (45 mi S Santa Ana, south-

eastern Sonora). The habitats of the two taxa differ widely: extreme desert and humid foothills, respectively. For these reasons we regard *L. dugesii* as a species.

Klauber (1940) was forced to leave the status of *L. dugesii* in doubt (although he considered it a subspecies of *L. humilis*), because at that time it was impossible to verify that the holotype of the species has 12 caudal scale rows rather than 10; it was only an educated guess that it does. Dr. Patrick David of the Muséum Nationale d'Histoire Naturelle of Paris, where the holotype is housed, kindly examined it for us, and confirmed that indeed it does have 12 caudal scale rows.

Masticophis bilineatus Jan. 11495, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m; 11675, La Loma, Moris (28°8′48.7″N, 108°31′40.8″W), 790 m.

Records of this species in Chihuahua have been limited to the extreme southwest and extreme northwest (Camper and Dixon, 1994; Lemos-Espinal et al., 2004). No. 11675 provides a known locality of occurrence between these two extremes. The anterior part of the venter is not red in either specimen, as described by Lemos-Espinal et al. (2004) for specimens from Chínipas. However, the present specimen from there is a juvenile 147 mm TTL.

Masticophis flagellum lineatulus Smith. 11669, betw Aldama and El Morrión (29°0′35.9″N, 105°38′59.6″W), 1286 m.

The specimen is a head only, 23 mm snout to end of parietals. The ventral surfaces of the head has a black spot or line on every scale. Four rows of round black spots are on each of the six ventrals present. There is a diffuse, more or less central, dark spot on most dorsals present.

Masticophis mentovarius striolatus (Mertens). 11461, 11497-8, 11500, 11523-4, 11684, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m; 11862, La Loma, Moris (28°8′48.7″N, 108°31′40.8″W), 790 m.

All are patterned alike, including a small one (11468) at 649 TTL, except for a juvenile (11684, head only), with a very distinctive pattern as compared with that of the adults and *M. flagellum*. The top of the head is brown. That color extends 2.7 head lengths onto the neck (all that is present), where irregular white transverse lines, less than a scale length long, cross the dorsum and extend onto the ends of the ventrals, separated from each other by a length of 1 or, usually, 2 scales. The light lines continue forward to the orbit. The sides of the head are brightly reticulated.

These markings, noted by Hardy and McDiarmid (1969) in the young of this species, are not present in the young of *M. flagellum*. The light bands are not at all evident in the other specimens of *M. m. striolatus*, even in the 649 mm juvenile. The reticulate markings on the sides of the head are only faintly evident in the 649 mm juvenile, and not at all in the adults. The change in pattern appears to occur abruptly between 562 mm TTL (calculated for 11684 on the basis of comparative head length/total length ratios) and 649 mm TTL. The subcaudal and posterior ventral surfaces, even to some extent in the juvenile, are yellow-red. All have 8 supralabials.

Pantherophis emoryi meahllmorum Smith et al. 11665, a male, km 2, El Morrión-Ojinaga (29°8′35.3″N, 105°25′8.7″W), 1452 m.

In an analysis of geographic variation in *Pantherophis emoryi*, Smith et al. (1994) recognized two subspecies—*P. e. emoryi* and *P. e. meahllmorum*. They noted variation in number of body segments (as determined by number of ventrals and subcaudals) and in number of body and tail blotches. The sharper distinction was found in body blotch counts, which indeed showed an overlap of only 2%, as the ranges of the subspecies were plotted. Therefore that was regarded as the key character separating the two subspecies, with a narrow contact zone from southeastern New Mexico, southeast to south-central Texas, thence northeastward through eastern Oklahoma and southern Missouri to extreme central western Illinois. However, with pattern used as the distinguishing criterion, the vertebral counts overlapped greatly, with diagnostically insignificant average differences. On the basis of blotch count, the present specimen, with 40 on body, 17 on tail, falls well with range of expectation of *P. e. meahllmorum* (100% < 45 as opposed to 2% in *P. e. emoryi*).

Vaughan et al. (1996) reviewed geographic variation of the same species in Texas (not over its entire range), and also recognized the same two subspecies, with ranges considerably different from those conceived by Smith et al. (1994) as required by their data on vertebral counts, which they gave greater emphasis, as a key character, than blotch counts. On that basis, they recognized an essentially northern subspecies, *P. e. emoryi*, and a southern one, *P. e. meahllmorum*, with a fairly broad belt of intergradation between the two subspecies extending in Texas along the Rio Grande from the New Mexico border to approximately Del Rio, thence passing about straight east. On the basis of their criterion of ventral counts, our specimen with 209 ventrals falls nearer expectation for *P. e. emoryi*, whereas the subcaudal count of 73 falls nearer expectation for *P. e. meahllmorum*—hence an intergrade by their criteria, as would be expected inasmuch as the area of intergradation in Mexico presumably would follow the Rio Grande much as in Texas.

Allocation of the present specimen to *P. e. meahllmorum* conforms with the concept of Smith et al. (1994), and is not materially inconsistent with that of Vaughan et al. (1996).

Pituophis catenifer affinis (Hallowell). 11580, Cañón del Oso, Sierra de San Luis (31°16′17.7″N, 108°43′7.0″W), 1661 m; 11662, Coyame (29°27′48.2″N, 105°5′1.2″W), 1270 m; 11664, Tomichi (28°22′51.4″N, 107°41′9.2″W), 2310 m; 11667, La Mula, nr la Aduana (29°8′22.7″N, 104°24′26.0″W), 1100 m; 11678, Arenopanuchi (27°30′27.1″N, 107°50′36.2″W), 2222 m; 11858, nr Ojinaga (29°34′3.2″N, 104°28′7.5″W), 910 m.

This subspecies is known from most of the state. Sympatry with *P. d. deppei* may occur in the state; the two species are rather widely sympatric elsewhere.

Pituophis deppei deppei (Duméril). 11857, Güicorichi (27°38′6.5″N, 108°28′19.0″W), 1500 m.

This is the second specimen from a known locality in Chihuahua. A full description has been submitted elsewhere.

Procinura aemula Cope. 11339, 11380, 11461-2, 11464-5, 11469-70, 11521, 11538-9, 11721-3, 11601, 11690, 11928-30, Chínipas (27°23′30.9″N, 108°32′9.7″W), 469 m.

The genus *Procinura* was resurrected from the synonymy of *Sonora* by Lemos-Espinal et al. (2004). Variation in those reported there and the present series is to be treated elsewhere (Lemos-Espinal, Chiszar and Smith, 2004c).

Rhinocheilus antonii Dugès. 11647, 11926, Valle de Tacupeto, Sonora (28°13′22.8″N, 109°19′5.6″W), 416 m. This locality is close enough to Chihuahua to suggest that the taxon may occur there.

The largest specimen is 810 mm SVL. The two have 201 and 208 ventrals, 42 and 54 subcaudals. There are 14, 15 blotches on body, 4-5 on tail. The light interspaces are 1/4 the length of the dark blotches, bright pink on dorsum and upper sides, white on lower sides; the middle of the blotches is without light color (in midbody blotches, on scale rows 13-19); at least the lowest dorsal scales in the blotches are with a median light streak; dark blotches extend onto the lateral quarter on each side of the ventrals; middle half of 1-2 ventrals opposite the light interspaces black. Head black above, with scattered white areas on lower lateral scales and tip of snout.

This is a very distinctive pattern as compared with that of *R. l. tessellatus*, but the nearest subspecies, *R. l. lecontei*, has a pattern variant similar to the normal pattern of *R. l. antonii*; it is so distinct that Klauber (1941) gave it the name of *R. l. clarus*. In effect, what is the *clarus* variant of *R. l. lecontei* is basically like the norm in *R. l. antonii*.

A categorical difference between *R. l. lecontei* and *R. l. antonii* is the presence of black spots on the middle of the venter, and extension of the black dorsal blotches onto 1/4 of the width of the ventrals on each side in the latter, their absence in the former, in which the venter is mostly unmarked. Bogert and Oliver (1945) have an excellent drawing depicting the unique features of the pattern of *R. l. antonii*.

According to Klauber (1941) and Medica (1975), *R. l. antonii* occurs essentially throughout Sonora, its range terminating abruptly at or near the boundary between that state and Arizona.

Stebbins (2003), on the contrary, depicted the range of *R. l. antonii* as limited in Sonora to the southern tip of the state. Populations elsewhere in Sonora he interpreted as *R. l. lecontei*.

Stebbins's (2003) interpretation makes ecological sense, whereas Klauber's (1941) does not. *R. l. lecontei* occurs in an arid habitat, which does not stop abruptly near the international boundary. It continues southward through central and western Sonora. *R. l. antonii* is a tropical species; occurrence in the severely arid habitat of most of Sonora is highly unlikely. Its range in Sonora is extended to about the middle of the state, on the extreme eastern border, by the specimens here reported.

In view of the absence of evidence of intergradation between these two taxa as conceived by Stebbins (2003); the presence of an apparently categorical difference in markings of the venter; the sharp difference in habitat; and the apparent distributional separation, we regard them as separate species. In so doing we revert to the rank originally assigned by Dugès (1886).

Rosenberg (1975a, b) recorded "*R. a. antonii*" from the Florida keys. It more likely was the *clarus* variant of *R. l. lecontei*.

Rhinocheilus lecontei tessellatus Garman. 11860, betw Escalón and Carrillo (26°43′47.0″N, 104°18′29.1″W), 1100 m.

This locality is near the southwestern edge of the range of the subspecies (Medica, 1975). The pattern is normal; the median 4-5 scale rows are pink in the spaces between the dark blotches; the body is black and white spotted laterally.

Salvadora deserticola Schmidt. 11499, 11502, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m.

These southwestern slope specimens do not differ in pattern from those in the eastern part of the state.

Senticolis triaspis intermedia (Boettger). 11619-20, Valle de Tacupeto, Sonora (28°17′30.3″N, 109°17′10.9″W), 555 m; 11645, Güisamopa, Sonora (28°39′1.9″N, 109°6′57.1″W), 860 m.

These localities are about in the middle of the western border of the state, some 200 km north of previous records.

Sonora semiannulata semiannulata Baird and Girard. 11608, betw Escalón and Carrillo (26°43′47.0″N, 104°18′29.1″W), 1100 m.

There are 15 midbody an 14 preanal scale rows; a nuchal light collar; 31 blotches on body, 13 on tail, all separated by pinkish interspaces; venter grayish, unspotted. The number of scale rows conforms with expectation for the subspecies.

Werler and Dixon (2000) recognized this as a polytypic species, accepting the validity of *S. s. taylori*, with 13 preanal scale rows and usually 13 also at midbody.

Sympholis lippiens rectilimbus Hensley. 11471, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m.

This male exemplifies one of the more bizarre species of snakes in Mexico. The tail is short and blunt, with only 20 subcaudals (the 2nd, 4th and 5th undivided); 214 ventrals (three split in the middle); anal entire, but with a central, longitudinal groove; 19-19 scale rows; internasals and prefrontals fused as one pair of scales, although between them there is a sliverlike scale reaching both rostral and frontal; one preocular, split on one side to form a loreal; one postocular; one anterior temporal; nasal broadly reaching lip; only one supralabial entering orbit; only four infralabials contacting the two pairs of chinshields, the posterior pair of which is half the size of the anterior, and separated by a single scale. The top of the head is black, followed by a straight-edged white nuchal collar; twenty black blotches on body, narrower on sides, narrowly incomplete ventrally and separated by white (in preservative) interspaces 2–3 scales long at midline, 4–5 at edge of

ventrals.

Except for having one loreal on one side of one (instead of none), this specimen as well as the two reported by Lemos-Espinal et al. (2004) from the same locality agrees with the diagnostic characters of the subspecies.

Tantilla wilcoxi Stejneger. 11454, km 13 betw Puerto Justo and Balleza (26°51′35.9″N, 106°7′9.2″W), 2040 m.

This damaged specimen has the diagnostic, black-bordered light band behind the head. The locality is well within the known range of the species.

Tantilla yaquia Smith. 11633, betw Basaseachi and Maicoba (28°23′34.8″N, 108°51′38.5″W), 1634 m.

This is the second type locality specimen known from Chihuahua, although the species is known as far north as southeastern Arizona, and as far south as Nayarit. The locality is about 75 km north of Guasaremos, the type locality and the only other known locality in Chihuahua. The specimen is typical, with a black cap on head extending 4 scale lengths onto nape, and narrowly light edged posteriorly. The light edge has no posterior black border.

Thamnophis cyrtopsis collaris Jan. 11399, 11472-4, 11496, 11696-7, 11865, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m. This locality lies well within the known geographical range of the subspecies (Rossman, 1996).

All of these specimens have a single, united nuchal black blotch, as is characteristic of this subspecies, separating it from *T. c. cyrtopsis*, in which the nuchal blotch is split into two. In addition, the lower margin of the lateral light stripe is lost posteriorly, so the stripe appears to cover scale rows 1–3. In *T. c. cyrtopsis* the lateral light stripe is sharply limited throughout its length to rows 2–3.

Thamnophis cyrtopsis cyrtopsis × *T. c. collaris*. 11679, 11681, Pitorreal (27°38′6.5″N, 107°47′45.3″W), 2310 m.

These two specimens are thought to be intergrades because one of them has the lateral light line diffuse posteriorly, as in *T. c. collaris*, but the nuchal blotches are separated, as in *T. c. cyrtopsis*. The other (11679) agrees completely with *T. c. cyrtopsis*, but on populational grounds it too is regarded as an intergrade.

The locality is in the approximate area of contact of the ranges of these two subspecies (Rossman, 1996).

Thamnophis cyrtopsis cyrtopsis (Kennicott). 11581, Cañón del Oso, Sierra de San Luis (31°16′17.7″N, 108°43′7.0″W), 1661 m; 11644, Güisamopa, Sonora (28°39′1.9″N, 109°6′57.1″W), 860 m.

These two specimens agree with the diagnostic character states separating this subspecies from *T. c. collaris*: the nuchal bloches are paired, separated, and the lateral light stripe is sharply defined throughout the length of the body. Both localities lie well within the known range of the subspecies (Rossman, 1996).

Thamnophis eques megalops (Kennicott). 11558, Colonia Juárez, Casas Grandes (30°18′38.9″N, 108°3′46.7″W), 1460 m.

This subspecies was recorded from the same locality by Tanner (1985).

Thamnophis melanogaster chihuahuaensis Tanner. 11340, Puente a Babuchivo (27°22′11.3″N, 108°7′48.8″W), 1524 m.

This juvenile, 165 mm SVL (tail incomplete), is uniform dark brown above. Each ventral has a dark basal edge, the anal is entire, and a median dark streak extends the length of the subcaudal surface.

Trimorphodon tau tau Cope. 11469, 11501, 11831, Chínipas (27°23′39.9″N, 108°32′9.7″W), 469 m; 11646, Güisamopa, Sonora (28°39′1.9″N, 109°6′57.1″W), 860 m; 11648, Valle de Tacupeto, Sonora (28°17′30.3″N, 109°17′10.9″W), 555 m.

Both localities in Sonora are about 200 km north of the northernmost localities recorded for the species (Scott and McDiarmid, 1984), except for a spot on their map in extreme northwestern Sonora. We doubt the accuracy of that indication, inasmuch as it is some 500 km north of the present record, in a highly arid habitat much different from the one occupied by the species elsewhere.

A light nuchal collar is present in all specimens, of the same intensity as the light interspaces between the blotches on the body. In 11646, 700 mm TTL, the ground color, between the dark blotches, is gray, hence the collar is gray. It is much lighter in the others.

Tropidodipsas sp. 11635, km 226, hwy 16 Chihuahua-Hermosillo, Sonora (28°26′12.5″N, 109°10′5.7″W), 1643 m.

This is a new species the description of which is to appear elsewhere (Lemos-Espinal, Chiszar and Smith, 2004b).

Acknowledgments

CONABIO kindly provided support for field work by JLE under projects U003, X004, AE003 and BE002. We are also much indebted to Dr. Patrick David for checking the holotype of *Catodon dugesii* in the MNHNP.

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Bull. Chicago Herp. Soc. 39(11):213-214, 2004

Book Review: *The Gopher Tortoise: A Life History* by Patricia Sawyer Ashton and Ray E. Ashton, Jr. 2004. 67 pp. Pineapple Press. Softbound $14.95* Hardbound $19.95*

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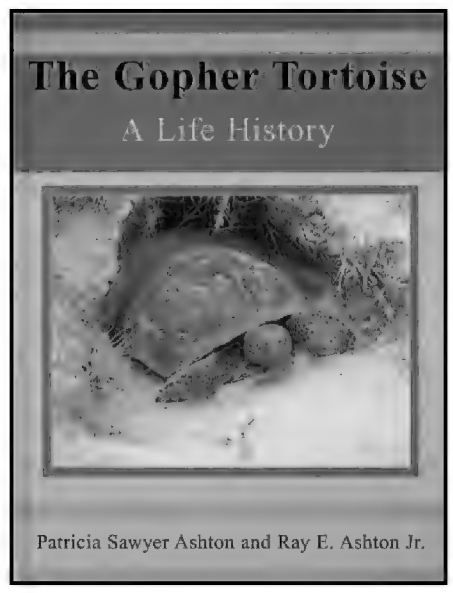

The Ashtons have been working with gopher tortoises for several decades. Fortunately, their interests are not limited to academic research but include the development of important conservation planning and land management techniques. A significant portion of the information presented in this book comes from observations and field studies Pat and Ray have conducted on their own biological preserve near Gainesville, Florida. Their 100-acre site is mostly upland habitats, and their well-studied gopher tortoise population has become an index for measuring successful community management. Pat has a strong background in science education, and much of Ray's life has been devoted to field studies and, more recently, conservation. Ray has never been hesitant in pointing out the many flaws in various state wildlife laws adversely affecting tortoise populations, and more importantly he has provided valuable suggestions for alternate solutions. Because of this combined experience I cannot think of any two people more qualified to author this particular book.

The book's title, *The Gopher Tortoise: A Life History*, actually understates the scope of this contribution. Much important information is also provided on such topics as the tortoise's ecology, tested management techniques, conservation needs and field research activities. The major sections of the book, each color coded, are: meet the gopher tortoise, the burrow, how we can learn about the gopher tortoise, daily life, where they live, and how to help the gopher tortoise. The book is brilliantly organized, both from an educational perspective and from the standpoint of simplicity. Page after page of basic information can evolve within the reader's mind into the complex mosaic of concepts necessary for gopher tortoise populations to exist. This is not a how-to conservation cookbook, as each management site will have its own specific needs. In the long haul, it will be educational contributions like this book, not laws and regulations, that will allow people to first appreciate, and then support, the need for protection of creatures such as gopher tortoises.

To its credit, this book is not bogged down in traditional academic style, nor was it designed to appease the predetermined standards of academic reviewers. I found it refreshing to read an informative publication uncluttered by scientific names and rambling professional jargon. The few unavoidable terms, like "assessment" and "canopy," that have different meanings to biologists and land managers are clearly defined in a glossary. Referring to "feces" as "poop" is something most readers will understand. This is a publication designed for anyone with curiosity. Even without an existing interest in gopher tortoises, readers will come away with an appreciation for the complexity of a seemingly simple reptilian lifestyle. Essentially each page is a self-contained lesson about these tortoises, and readers are drawn into the unassuming text through an array of colored photographs complementing the concepts as they are discussed. Because of this photo-rich layout I suspect many readers will discover themselves enjoying portions of the text that they would have otherwise skipped over.

In addition to information addressing the tortoise per se, the authors provide a brief review of the fossil history of southeastern North American tortoises, a glossary, bibliography, and an appendix listing all the animal species discussed in the book, many of which are commensals, or otherwise regularly associated with gopher tortoises. Most importantly, they also include a list of agencies and organizations (including addresses, websites, and other contact information) that are responsible for overseeing these tortoises. While for many much of all this would seem to be very basic information, keep in mind this is a region where rural folks still refer to pocket gophers as "salamanders" and to tortoises as "gophers."

Any future edition would benefit from inclusion of lists of the characteristic plants of the primary habitats occupied by gopher tortoises. Likewise, descriptions of natural flatwood, scrub and sandhill communities along with more details of the successional events that produce and eventually degrade them would be informative and useful to land managers concerned with the long-term needs of these tortoises.

As Florida continues to be developed, conflict between people and tortoises competing for upland sites will escalate.

There are growing concerns with legal issues for landowners, developers, enforcement agencies, and the conservation community. The gopher tortoise is not an animal that we should allow to someday exist only in state parks and national forests. It is a keystone species: a wide variety of upland creatures are dependent upon, or at least benefit from, its presence. A significant portion of upland fauna would locally disappear in this tortoise's absence. This book will allow those who care about conservation to choose correct decisions without delaying needed initiatives with the standard line: "we need more research."

The Ashtons have compiled the information biologists and land managers have learned over the last three decades and brought it to the public in a way everyone can understand. More importantly, they have good, and practical, suggestions for private-sector involvement in the conservation of both tortoises and their habitats. This book should be in every school and regional library and on the bookshelf of every zoning board within the range of the gopher tortoise. It is a good model for future works addressing other species-focused conservation efforts.

Bull. Chicago Herp. Soc. 39(11):214-216, 2004

HerPET-POURRI

by Ellin Beltz

Wee beasties of Hawai'i

A particularly plump envelope turned out to be an amazing arrival. Attached to a copy of the late Sean McKeown's *A Field Guide to Reptiles and Amphibians in the Hawaiian Islands* was a note from Paul Breese. He writes that the revised edition should be out by the time you read this and will be available from Wendy McKeown, POB 7006, Los Osos, CA 93402. The latest edition includes a newly widespread species, coqui frogs. Long-term readers may know that Sean was my editor at *Vivarium* Magazine which was purchased by *Reptiles* some time after Sean's continuing battle with heart disease required him to step down. Before that, though, I remember many a phone call from California; that familiar "Hmmmm" and a merciless word by word edit of a column the size of this every two months. Thanks, Sean, wherever you are for the writing lessons!

Punalu'u Dreaming

The other clipping in Paul's envelope is about a place I've been and wish I could go again, any day, live or in a daydream. Visit my website < http://ebeltz.net/hawaii1.html> for a glimpse of a fortnight of romping, stomping geology—punctuated with exquisite natural history experiences—including an unforgettable swim with the sea turtles at Punalu'u Beach. Recently volunteers and workers from Hawaii Volcanoes National Park watched as tiny hawksbill sea turtle hatchlings made the long march on black sand out to that shallow lagoon opening onto the Pacific. The water in the lagoon is salt above and warmer fresh water below as there is a spring which feeds it and the older turtles float in the water like barrels, feeding off the rocks and resting on the shores when tired. We didn't see any babies; but this beach has released thousands over the years. [*West Hawaii Today*, October 21, 2004, from Paul Breese] Curiously, another clipping on the desk, from the *Chicago Tribune*, shows children looking at a Kemp's ridley sea turtle. It is one of three about to be released in Massachusetts! [August 26, 2004]

Range Extensions

• A two-foot-long alligator was captured in Lake Michigan by homeowners in Long Beach, Indiana. The alligator clamped onto a stick it was offered; once on shore, it was dumped in a hamper and Department of Natural Resources was contacted. Named "Big Al," it was placed on display in a Michigan City pet shop. It's reportedly "very tame" but every effort to find an owner, translocator or other human responsible for its placement in the lake has been unsuccessful. A conservation officer said, "I've been up here for 23 years and I've never seen an alligator in our inland lakes or Lake Michigan in this county but it does happen on occasion throughout the state." [*South Bend Tribune*, October 27, 2004, from Garrett Kazmierski]

• Wildlife biologists in Georgia and Florida are scrambling to find out if the Cuban tree frog found in a Savanna, Georgia, backyard was a singleton—or if they should be on the lookout for a few individuals, a few dozen frogs or a full scale invasion. Eighty years or so ago, they invaded Florida and have been slowly moving northward, eating native bugs and frogs as they grow. [*USA Today*, October 26, 2004, from Bill Burnett]

• A woman in Rockford, Illinois, "found the first snake in her home in April 1999. . . . Little did she know that was just the beginning. . . . This fall, as they mark six years in the well-kept, brick home, they estimate they've removed 100 snakes from inside their house." They're garter snakes and nothing works. They plugged every gap with steel wool and caulk, only to find it dislodged. Now they use concrete patch. [*The Daily Journal*, Kankakee, Illinois, October 11, 2004, from Donna Moe]

Jake the Dead Snake

"American wrestling star Jake the Snake has been convicted of causing unnecessary suffering to a 12-foot python at his former home in London Colney. Jake, real name Aurelian Smith, Jr., was tried in his absence at St. Albans Magistrates' Court this week, along with his friend and business partner, London Colney grandmother Valerie Burnham, who was acquitted. The Burmese python, named Damian, was found coiled in a small Perspex cage by an RSPCA inspector in the garage of the house that Smith shared. . . . It was severely underweight and had mites and a serious mouth infection, which led to its death from pneumonia three weeks later, after it had been taken in by a specialist vet. The cage was too cold for it and

the court heard a snake that size should have had a whole room. . . . Smith, who is known for his gimmick of throwing a snake on defeated opponents, has appeared with Damian on television with celebrities such as chat show host Graham Norton and rock star Alice Cooper. The 49-year-old, who moved to Guildford in Surrey six months ago, had earlier pleaded not guilty, but failed to appear on Monday, November 1. His solicitor . . . said he would have changed his plea and did not attempt to defend him. During the trial it emerged that the giant wrestler actually had a phobia of snakes. [*Hertfordshire Now*, November 5, 2004, from Google.news]

Smart turtles?

In this heavy and unusual hurricane season, perhaps it should not be surprising that there were fewer than usual numbers of nesting turtles on beaches from Florida through North Carolina. A clipping dated August 8, 2004, from *The South Bend Times* says that this year, loggerheads laid about 300 nests in North Carolina; the average is 750. Do you think perhaps the turtles are keyed into weather patterns we puny humans are just learning and know better than to waste their eggs on storm-tossed beaches? Researchers have noted a biennial pattern before; more turtles nest every other year. [from Jack Schoenfelder]

All in a day's work

"30 ft up, Dino decides he does not want to be rescued. . . . Dino the iguana, green, scaly and 5 ft long from nose to tail . . . escaped three weeks earlier from a neighboring house in . . . Liverpool and then decided to climb 30 feet up a [tree] to survey the neighborhood. Soon the fire brigade and RSPCA had been called into action. . . . It wasn't going to be that easy. . . . The tree was too bendy to put a ladder against . . ." and while they were figuring out how not to rescue the iguana, a local man climbed the tree and became part of the problem when the iguana clawed and bit him. Finally a RSPCA inspector climbed up too, and all returned to terra firma. "Dino, who is thought to have survived on eggs from birds' nests, is unlikely to be going on any more jaunts as he is being moved to a more secure tank," according to London's *Daily Mail*. [September 1, 2004, from Bill Burnett's Mom, via Aunt Peggy]

A giant sucking sound

The *Chicago Tribune* reports that a new kind of reptile, discovered two years ago in China, has been studied by a couple of University of Chicago professors and found to be quite unusual. Named *Dinocephalosaurus orientalis*, the terrible headed lizard of the east, it lived during the Triassic. It had a long body and an even longer neck ending in a small head. They theorize it may have floated in murky waters and used the long neck to sneak up on food; suctioning in prey items without warning. [September 24, 2004, from Bill Burnett]

Lost and dumped

"A pregnant tortoise missing for about a week [from Kokomo, Indiana] was returned home unharmed in an Army duffel bag. . . . [The owners] discovered their 90-pound African spur thigh tortoise . . . on their front porch. . . . Missing since someone was seen about a week ago taking her from the couple's back yard . . . [she] was hungry but otherwise safe. . . . After devouring a banana and an ear of corn, she was released into her backyard home, where she spent the night huddling with her mate . . . in a doghouse." [*South Bend Tribune*, August 18, 2004, from Jack Schoenfelder]

Caveat emptor

Chinese entrepreneurs imported tens of thousands of tropical Thai crocodiles in an effort to establish southeastern China as a major supplier of meat and leather. Unfortunately, in the cooler climes, males eat more and become uninterested in sex. One of the managers of a crocodile farm with 60,000 to 70,000 animals said, "They don't chase the females, they're just very fat guys, they just eat, eat, eat." The temperature situation also results in sick animals. It wasn't supposed to be that way. Panyu's Crocopark was planned as the world's largest crocodile breeding facility and "bought nearly 40,000 crocodiles from Thailand in 1997 and 1998, ranging in length from 30 inches to six feet and entirely filling the holds of five chartered Boeing 747 cargo jets. The Asian financial crisis had driven down prices for live crocodiles by as much as 75 percent, and the Thai farmers engaged in panic selling when their bankers called in loans," according to the *New York Times* [October 23, 2004, from Lori King]. The Thais sold the Chinese unsexed groups; so now the park has more males than it needs. Also many of the largest females are past their prime. Crocopark has killed so few animals that none of the local tanneries have converted to the processes needed to handle reptile skin. And, in a final blow to the area, last year's outbreak of SARS devastated tourism in Guangdong Province. Crocopark planted gardens and built tourist facilities as part of the provincial effort to attract tourists following worldwide bad publicity, but the area continues to lag and the huge facilities stand mostly empty.

Caveat diner

"The 54 kinds of wild animals now legally available at restaurants include spotted deer, foxes, roe deer, pheasants and ostrich. Wild frogs and snakes are officially still illegal, although these two are very popular with Shanghai diners. Wild frogs and snakes have been banned from restaurants since the SARS epidemic last year, but recently they have begun to return to the table. They may not appear on official printed menus, but when diners request them many popular restaurants in town will provide them. . . . Most of the snakes and frogs in the market are wild. `To raise domesticated snakes costs too much, as they grow too slowly. . . . A snake has to grow a few years before it reaches a marketable weight.' Some wild animals which are protected in Shanghai are not in other parts of China, which means Shanghai restaurants can evade local bans by claiming the animals were imported from outside the city. `We can interfere if the frogs are from Shanghai's Nanhui or Fengxian, but once we caught a seller with frogs from East China's Qingdao,' the wildlife agent said. `He even had a license from the local forestry administration.' China's 10-year-old national Wild Animal Protection Law is currently in the process of being amended, which may help solve this kind of problem in the future." [*Shanghai Star*, November 4, 2004, from Yu Wang]

Survival of the fittest

• "[The police sergeant] knew the streets would look like a green snowfall and that roofs would come off and trees would blow down. He was even prepared to find death on the morning after Hurricane Ivan hit his beachfront town. . . . Then shots rang out to his left, beyond the flooded parking lot. . . . Employees of the Alabama Gulf Coast Zoo were trying to find and kill their escaped alligators before any of them got too far away, especially Chuckie, the 12-footer. . . . The zoo's front gate was under 4 feet of water." Most of the other animals were evacuated, but the gators were considered too cumbersome to move and not a problem until the storm brought huge floods. [*Chicago Tribune*, September 17, 2004]

• "Chucky, the fugitive out of Gulf Shores, Alabama, proved . . . that you can go home again. At least you can when you're a 12-foot, 1,000-pound American alligator. After disappearing last week during Hurricane Ivan, the Alabama Gulf Coast Zoo's star attraction was found . . . in a sludgy drainage ditch inside zoo grounds. Gator trackers captured him with a noose and heavy duct tape, and state troopers and local police officers returned him to the shallow pond where he has lived for 15 years. [*Chicago Tribune*, September 23, 2004, from Ray Boldt]

Go Tyrone!

National Geographic Mission Programs and Microsoft are sponsoring Tyrone Hayes, biologist and herpetologist as he studies the interactions between frogs, water and human health. Recently NG reported that "his findings revealed that some species [of African reed frogs] change color when exposed to polluted water." They can now be used "as an almost cost-free way to detect toxins in human water supply in developing countries." [*National Geographic*, probably September or October 2004 from Mrs. P. L. Beltz, now 82 and mostly forgetful of putting the date slug on what she sends.]

Do what? Where? When?

"A 20-year-old woman died after an alligator bit off her arm after she apparently went out for a predawn swim in a lake near her grandparents' house [near Fort Myers, Florida]." She and her father were in town for a visit. Lakes in Florida are known to have alligators, there was no explanation for her early morning swim. [*Commercial Appeal*, Memphis, Tennessee, from Bill Burnett]

Myth-ing beasts

• A Houston movie multiplex that was showing "Anaconda" among other titles was shut down so workers could search for a snake described to be at least 8 feet long. "A maintenance worker said he saw a snake about a week ago that was thick as a man's arm slithering along a wall. . . . As soon as he saw it, he left. . . . I think everyone who was working left," said a spokesman for the theater company. They called Critter Control, which was unable to find the beast. [Kankakee *Daily Journal*, October 1/2, 2004, from Donna Moe]

• "Churubusco, near Fort Wayne, holds an annual Turtle Festival to celebrate a legendary 5-foot, 500-pound turtle named Oscar. The "Beast of Busco" was spotted in a nearby lake in the 1940s. Snapping turtles are game animals. . . . A hunting or fishing license is required to collect them. The first news reports of this beast were March 9, 1949; by the 14th of the month 3,000 people had tramped around the Harris farm looking for Oscar. The Hoosier Conservation newsletter [Fall 2004, from Garrett Kazmierski] neglects to give the dates of the annual festival.

People and their pets

• Emmy nominee Will Ferrell has been a cast member of Saturday Night Live for seven seasons. He graduated high-school in Irvine, California, where he was cofounder of the Reptile Club. [*People* Magazine, October 11, 2004, from Bill Burnett]

• "Bears defensive end Michael Haynes says he started collecting turtles several years ago while getting his degree in animal sciences. . . . [Now he keeps] more than a dozen at . . . home outside Chicago. . . . The turtles swim in a 75-gallon tank, stroll in the garden, and, to Haynes, are the perfect pets after a long day of taking a pounding on the field. . . . He says, "You can just sit there and watch them." [*Sports Illustrated*, September 27, 2004, from Bill Burnett]

• "Even then she was on top of this reptile thing . . . " See the photo that brought out this comment: http://ebeltz.net. Click on it for a view inside my head.

Boy, skip a month and watch your old friends come out of the woodwork! Special thanks this month to Bill Burnett's Aunt Peggy and his Mom, as well as Bill Burnett, Allen Salzberg, Wes von Papineau, Donna Moe, Lori King, Garrett Kazmierski and everyone else who even thought of sending stuff in. Take whole sheets of newspaper or magazines and mail them to me: Ellin Beltz, POB 1125, Ferndale, CA 95536. Letters and links to my email < ebeltz@ebeltz.net> .

Herpetology 2004

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editor assumes full responsibility for any errors or misleading statements.

SNAPPING TURTLE TAIL MOVEMENTS

J. S. Willey and R. W. Blob [2004, J. Herpetology 38(3):360-369] note that chelydrids (including snapping and big-headed turtles) are unusual among extant turtles in possessing long, robust tails. In other lineages of quadrupedal reptiles, long tails perform critical functions during both terrestrial and aquatic locomotion, and the tails of common snapping turtles have been shown to help stabilize juveniles as they ascend terrestrial slopes. However, common snapping turtles live primarily in aquatic habitats, and the function of the tail in these environments has not been examined. The first step to evaluating the role of the chelydrid tail in water is to evaluate its pattern of motion; therefore, the authors collected high-speed digital video of tail kinematics from juvenile common snapping turtles (*Chelydra serpentina*) during aquatic walking. Common snapping turtles hold the tail off the substrate and move it as a nearly rigid strut during aquatic walking, cyclically flexing it side to side by 11–12° from the body midline. These motions occur one-quarter cycle out of phase with the motions of the limbs; thus, the timing of tail movements suggests that they are likely not a passive consequence of hind-limb retraction and are likely controlled by one (or a combination) of tail muscles, rather than ipsilateral hind-limb retractors. The potential for tail movements to contribute to aquatic thrust in common snapping turtles is uncertain. However, common snapping turtle tail movements resemble those of salamanders and lizards in many respects, suggesting that common snapping turtles might retain primitive tetrapod or sauropsid features of tail motor control despite possessing a radically divergent body plan.

MINK FROG CALLING

C. R. Bevier et al. [2004, Amphibia–Reptilia 25(3):255-264] studied the calling behavior of male mink frogs, *Rana septentrionalis*, and how their calling activity varied through nightly calling periods. They observed focal males during their summer breeding season for 1 h periods during chorus activity, which extends from midnight until 0900h, and recorded call types and rates. During this period, male *R. septentrionalis* produced a repertoire of single and multi-note calls composed of one or two note types, referred to as cuk and rumble notes. Calls that included series of both note types were most frequent between 0100 and 0330h, while single cuks were primarily produced early and late in the chorus period. Call rate peaked between 0200h and 0300h, declined until dawn, then increased until 0900h. Call properties were analyzed from recordings of male vocalizations; temporal properties, such as call and note duration, were the most variable, both within and among males, whereas spectral properties, such as dominant frequency, varied the least. In general, males produced the most complex and variable calls during a peak period of calling activity.

BARKING FROG HABITAT USE

C. S. Goldberg and C. R. Schwalbe [2004, J. Herpetology 38(3):305-312] note that barking frogs (*Eleutherodactylus augusti*) are the northernmost ranging member of the large tropical family Leptodactylidae. They investigated the ecology of this saxicolous species at the northern edge of its range in a canyon in southern Arizona. Fifty-four frogs were captured on discontinuous rock outcrops; eight of nine females and 39 of 45 males were on limestone outcrops. The remaining frogs were closer to limestone outcrops by more than 200 m than would be expected if they were distributed randomly with respect to limestone formations. Seven of 10 frogs radio-tracked had core home ranges (50% fixed kernel) from 94 to 100% on limestone; the other three frogs did not have any part of their home range on limestone outcrops. During five years of mark–recapture efforts, no frogs were found on a different outcrop from the one where they were originally captured; no radio-tracked frogs moved between outcrops during the breeding season. An estimated four to 20 barking frogs occupied each outcrop; these groups probably are connected primarily by juvenile dispersal. As an organism living at the edge of its range, barking frogs in Arizona may rely heavily on extensive underground areas such as those found in limestone to protect them from a physiologically challenging environment. To manage for the persistence of barking frogs in southern Arizona, it is necessary to identify and protect habitat patches and movement pathways among them.

WOLF SNAKE DENTITION

K. Jackson and T. H. Fritts [2004, Amphibia–Reptilia 25(3): 247-254] note that the common wolf snake, *Lycodon aulicus capucinus*, is a species known to feed on hard-bodied prey such as skinks. This paper examines in detail the dentitional morphology of *L. aulicus capucinus* to see whether it possesses morphological specializations for durophagy comparable to those found in other squamates. *Lycodon aulicus capucinus* has greatly enlarged anterior maxillary teeth, followed by a large diastema. At the diastema, the maxilla is significantly arched. The diastema is followed by a row of small, closely-packed teeth. Finally, after a short second diastema are enlarged, but ungrooved posterior maxillary fangs, with the posterior surfaces modified into blades. The authors propose that this dentition helps *L. aulicus capucinus* to ingest hard-bodied skinks in several ways: the enlarged anterior teeth and arched maxilla encircle the prey during biting, preventing it from being squeezed out of the mouth anteriorly; the short, spatulate teeth may catch under the scales of the prey, preventing escape during swallowing, and the bladelike posterior fang may slice through the hard, cycloid scales of the prey.

Unofficial Minutes of the CHS Board Meeting, October 22, 2004

Lori King called the meeting to order at 7:33 P.M. Board members Matt Campbell, Jim Hoffman, Ed Rzewnicki and Jenny Vollman were absent.

Officers' Reports

Recording Secretary: Melanie Aspan read the minutes of the September 17 board meeting and they were accepted.

Treasurer: In Jim Hoffman's absence Lori King presented the September balance sheet. A new, more user-friendly format is being employed beginning this month.

Membership Secretary: Mike Dloogatch presented the membership chart. Linda Malawy inquired how many new members have joined after learning about the CHS at the 2004 Tinley Park Breeder's Show. Mike Dloogatch answered that so far there have been 8 new members directly attributed to Tinley.

Vice President: The Sierra Club will be making a presentation regarding Shawnee National Forest at the November elections meeting.

Corresponding Secretary: Steve Spitzer informed the Board that a legal claim was filed regarding the estate of Edward Wright. Reportedly this claim does not affect the items accepted by the CHS, only monetary funds presented to other organizations.

Sergeant-at-arms: Brian Jones reported 51 attendees at the September General Meeting.

Committee Reports

Shows: At Jenny Vollman's behest Lori King announced that in addition to the Notebaert weekends November 6–7 and December 26–27, there will be an afternoon show on October 30 at Garfield Park featuring Nocturnal Herps and an evening show on November 19 at Gompers Park. Steve Spitzer raised the issue of the CHS insurance covering only 4 show days per year and suggested that the Board should find out what the per diem charge would be for days exceeding 4 in any given year. It was discussed that the show days involved with Reptile Fest plus the Arlington Family Pet Show put us at least one day over this quota. It was decided that the Board may not be willing to pay for the booth space at the Arlington Family Pet Show if this show also involved an additional insurance fee. It was further decided that Jim Hoffman should be instructed to hold off on sending the check to pay for the booth space (if it has not already been sent) pending further discussion.

ReptileFest: The CHS is now the proud owner of the URL www.reptilefest.com. This link now takes internet users to the ReptileFest page of the CHS website. Steve Spitzer presented a sample of the AOL City Guide – Chicago Weekender. He suggested that Board members be on the lookout for additional avenues to spread the word about ReptileFest such as this newsletter. John Bailey suggested that more CHS shirts in evidence at this year's fest would be a welcome sight. He suggested the possibility of presenting free shirts to members that participate in other shows throughout the year as a good way to accomplish this.

Raffle: It was agreed that the 15-minute time limit worked well and should continue to be enforced.

Adoptions: Linda Malawy announced that since her last report on August 13, the adoptions program has brought in $700 in donations. She also mentioned that cricket sales have raised a total profit of $506 since begun in July 2003.

Nominating: The Committee presented a slate at the September General Meeting as follows: President—Lori King; Vice-president—Linda Malawy; Treasurer—Jim Hoffman; Recording Secretary—Melanie Aspan; Membership Secretary—Steve Spitzer; Publications Secretary—Mike Dloogatch; Corresponding Secretary—Deb Krohn; Sergeant-at-arms—Ron Humbert; Members-at-large—Sean Bober, Betsy Davis, Steve Sullivan and Jenny Vollman. Jennifer Spitzer was nominated from the floor for the position of Member-at-large.

Conservation: Lori King reported that the Carlyle Lake massasauga research efforts are continuing; however, government spending has been severely cut and currently the project has no government funding at all. Mention was made of the money allocated for this purpose by the CHS. Lori also announced that Lee Jackson of the National Mississippi River Museum and Aquarium has arranged for the CHS massasauga conservation T-shirts to be sold in their gift shop with $1 from the sale of every shirt going into the CHS massasauga conservation fund. Lori related that the recent Grand Cayman blue iguana hatchlings will soon be released to the wild despite hurricane Ivan's influence in the area. She also mentioned that the documentary "Too Blue to Lose" is soon to be released on DVD.

Chicago Wilderness: Steve Spitzer reported that he attended the communications workshop sponsored by Chicago Wilderness. He related that the seminar focused on successfully attracting the attention of the media to specific causes.

Old Business

North Park Village: Steve Spitzer announced to the Board that there will be a $50/month fee charged if we continue to hold the monthly Board meetings at North Park Village. He elaborated that the November 2004 meeting will be allowed free of charge and if the Board commits to a one-year contract, one month of that year would also be free of charge.

Reimbursement for Field Museum Show Parking: Lori King related on behalf of Jenny Vollman that this matter is still pending. A decision was made to turn it over to the Treasurer if the funds haven't been received in another month.

AV Equipment: Steve Spitzer reported that the CHS does not fit Dell's requirements for a grant. A decision was made to hold off on any decision until Jim Hoffman could be consulted regarding a discount.

Croc Relocation: The Board was very relieved to be told by Bob Bavirsha that a rumor circulating regarding the slaughter-

ing of alligators at Florida's Gatorland is false. It was agreed that Bob should be reimbursed for his travel expenses incurred transporting unwanted alligators to Florida, and that the funds donated through Adoptions that directly resulted from alligators should go toward the blood testing that Bob wants to do.

New Business

Donation to Herp Digest: Matt Campbell had forwarded a request for a donation to help with operating expenses of the free electronic newsletter "Herp Digest." A decision was made not to make a donation after Mike Dloogatch mentioned that the editor, Alan Salzberg, has had a close association with the Humane Society of the United States.

General Meeting Change: Lori King brought up the idea of changing the night of the General Meeting from Wednesday to Friday in the hope that more members would be able to attend. The general feeling was that this would be a positive change. A decision was made to ask the membership present at the October General Meeting what their feelings are on this topic.

Round Table

Melanie Aspan regretfully announced that she would be unable to attend the November Board Meeting.

The meeting was adjourned at 11:00 P.M.

Respectfully submitted by Melanie Aspan, Recording Secretary.

Advertisements

For sale: rats and mice—pinkies, fuzzies and adults. Quantity discounts. Please send a SASE for pricelist or call Bill Brant, *THE GOURMET RODENT*, 6115 SW 137th Avenue, Archer FL 32618, (352) 495-9024, E-mail: GrmtRodent@aol.com.

For sale: from **The Mouse Factory**, producing superior quality, frozen feeder mice and rats. We feed our colony a nutrtionally balanced diet of rodent chow, formulated especially for us, and four types of natural whole grains and seeds. Mice starting from: pinks, $.17 each; fuzzies, $.24 each; hoppers, $.30 each; weanling, $.42; adult, $.48. Rats: starting with pinks at $.45 each, to XL at $1.80 each. Discount prices available. We accept Visa, MC, Discover or money orders. PO Box 85, Alpine TX 79831. Call **toll-free** at (800) 720-0076 or visit our website: < http://www.themousefactory.com> .

For sale: **high quality frozen feeders**. Over a decade of production and supply. Seven sizes of mice availabe: small newborn pinks up to jumbo adults. Prices start at $25 per 100. Feeders are separate in the resealable bag, not frozen together. Low shipping rates. Free price list. Kelly Haller, 4236 SE 25th Street, Topeka KS 66605, (913) 234-3358 evenings and weekends.

For sale: books. *The Last of the Ruling Reptiles* by Wilfred T. Neil, 1971, Columbia University Press, 486 pp., 162 figs. (b&w photos, range maps), extensive bibliography, comprehensive reference, $75; *The British Reptiles and Amphibians* by Malcolm Smith, 1973 (5th ed.), 322 pp., 91 figs., 16 b&w plates, comprehensive natural history, $30; *Records of the American-Australian Scientific Expedition to Arnhem Land - Volume 4 - Zoology* edited by R. L. Specht, Melbourne University Press; 533 pp. (35 pp. on reptiles and amphibians), b&w plates, $80; *The Paintings of Guy Coheleach* by Nancy Neff; 1982 (1980), 243 pp., 154 illlustrations including 59 plates in full color (terrific prints of Coheleach's paintings), excellent text, too, $42. All books hardbound and in excellent condition. Prices include postage. Books make good Christmas presents. Send e-mail address for complete list. William R. Turner, 7395 S. Downing Circle West, Littleton, CO 80122, (303) 795-5128. E-mail: toursbyturner@aol.com.

For sale: c.b. '03 yellow anacondas, aggressive feeders, perfect health, about 2' long, $100 each; also c.b. '04 reticulated pythons; beautiful hatchlings already feeding on adult mice. These guys are tiger siblings and are available for $100/each as well. Personal checks, money orders and Paypal accepted. Out of state shipping available. If you have questions or would like to purchase an animal call Mark Petros, (847) 836-9426 or E-mail ballpython777@yahoo.com.

Herp Tours: Why pay more? Travel with the International Fauna Society, a 501 (c)3 not-for-profit organization, and experience the Costa Rican rainforest! Stay at the beautiful Esquinas Rainforest Lodge in the untouched herpetological paradise that is Piedras Blancas National Park. Meet new friends, relax in the naturally-filtered swimming pool or in the lush, fauna-filled tropical garden. Discounts for IFS and Chicago Herp Society members. For details, visit The International Fauna Society website at www.faunasociety.org or E-mail: info@faunasociety.org.

Herp tours: Adventure trips to **Madagascar**! Journey somewhere truly unique to seek and photograph nature on the world's least-studied mini-continent. For maximum herp fun and discovery, join Bill Love as we go where few people will ever venture in their lives. Let his experience assure a comfortable tour finding the most colorful and bizarre species on the planet! Get all the details at Blue Chameleon Ventures' comprehensive new website: < http://www.bluechameleon.org> , E-mail: bill@bluechameleon.org, or call (239) 728-2390.

Herp tours: The beautiful Amazon! Costa Rica from Atlantic to Pacific! Esquinas Rainforest Lodge, the Osa Peninsula, Santa Rosa National Park, and a host of other great places to find herps and relax. Remember, you get what you pay for, so go with the best! GreenTracks, Inc. offers the finest from wildlife tours to adventure travel, led by internationally acclaimed herpers and naturalists. Visit our website < http://www.greentracks.com> or call (800) 892-1035, e-mail: info@greentracks.com.

Reptile Show: Captive-bred only. Monona Community Center, 1011 Nichols Road, Madison WI. Saturday, April 23, 2005, 10 A.M. to 4 P.M., $4 admission, $2 under 12. Vendors tables, $25. Info: wireptileshows@hotmail.com or 608-238-2891

Wanted: Female ball pythons, adults preferred but smaller animals also considered. I am a professional breeder specializing in ball pythons and I can assure you that your animal will be provided with excellent care and optimal living conditions. Mark Petros, (847) 836-9426; ballpython777@yahoo.com.

Wanted: I'm looking for my soulmate. I want to settle down to a family before it is too late. But I have this problem. . . . When we get into hobbies and interests: old popular records, jazz and show tunes, and antique electronics are fine, but when I mention turtles, "What, are you crazy?" So maybe this is a better place to look. Please don't try to separate me from my turtles—at least not most of them. If interested, please drop a line to Ellis Jones, 1000 Dell, Northbrook IL 60062, telling a bit about yourself and giving a phone number.

Line ads in this publication are run free for CHS members — $2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to: Michael Dloogatch, 6048 N. Lawndale Avenue, Chicago IL 60659, (773) 588-0728 evening telephone, (312) 782-2868 fax, E-mail: MADadder0@aol.com.

You are invited to exhibit at the 12th annual ReptileFest

It's never too early to start thinking about your ReptileFest exhibit. Special recognition and prizes will be awarded to the best exhibits at ReptileFest in the categories of People's Choice, First-Time Exhibitor, and the prestigious Exhibitor's Choice. You don't need an animal to exhibit at ReptileFest, just an educational, entertaining, and attractive display where visitors can learn more about reptiles and amphibians. Some ideas for exhibits include a focus on ecology, adaptations, variation, behavior, best beginner herp, reproduction, conservation and diet. Full details about the awards will be available soon.

The Chicago Herpetological Society presents

ReptileFest 2005

April 2-3

10am to 5pm

The Nation's Largest Educational Reptile and Amphibian Show

If you're an experienced keeper looking for expert advice, a novice wondering about a starter herp, or someone just interested in snakes, turtles or frogs, this show's for you!

- Hundreds of spectacular reptiles and amphibians
- 40,000 square feet of exhibits, vendors and games
- Talk with experts about care and handling
- Touch or hold alligators and giant snakes
- Crawl with tortoises
- Have your picture taken with cool critters
- Enjoy fantastically fun family activities
- Purchase preferred products for herp pets

ReptileFest 2005 is proudly sponsored by:

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Visit our website at www.chicagoherp.org

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University of Illinois-Chicago, P.E. Building

901 W. Roosevelt Rd. (One block west of Halsted), Chicago

Admission: Adults $8.00 • Children (3-11) $6.00

UPCOMING MEETINGS

The next meeting of the Chicago Herpetological Society will be held at 7:30 P.M., Wednesday, November 24, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. This meeting will include the annual election of officers and members-at-large of the CHS Board of Directors. In addition to the elections, the meeting will feature representatives of the Sierra Club speaking to us about their efforts in the Shawnee National Forest in southern Illinois.

The regular monthly meetings of the Chicago Herpetological Society take place at Chicago's newest museum — the **Peggy Notebaert Nature Museum**. This beautiful new building is at Fullerton Parkway and Cannon Drive, directly across Fullerton from the Lincoln Park Zoo. Meetings are held the last Wednesday of each month, from 7:30 P.M. through 9:30 P.M. Parking is free on Cannon Drive. A plethora of CTA buses stop nearby.

Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? If so, mark your calendar for the December 17 board meeting. The site of this meeting is still undecided as of this writing. If you think you might like to attend, please call Steve Spitzer, (773) 262-1847, to get the details.

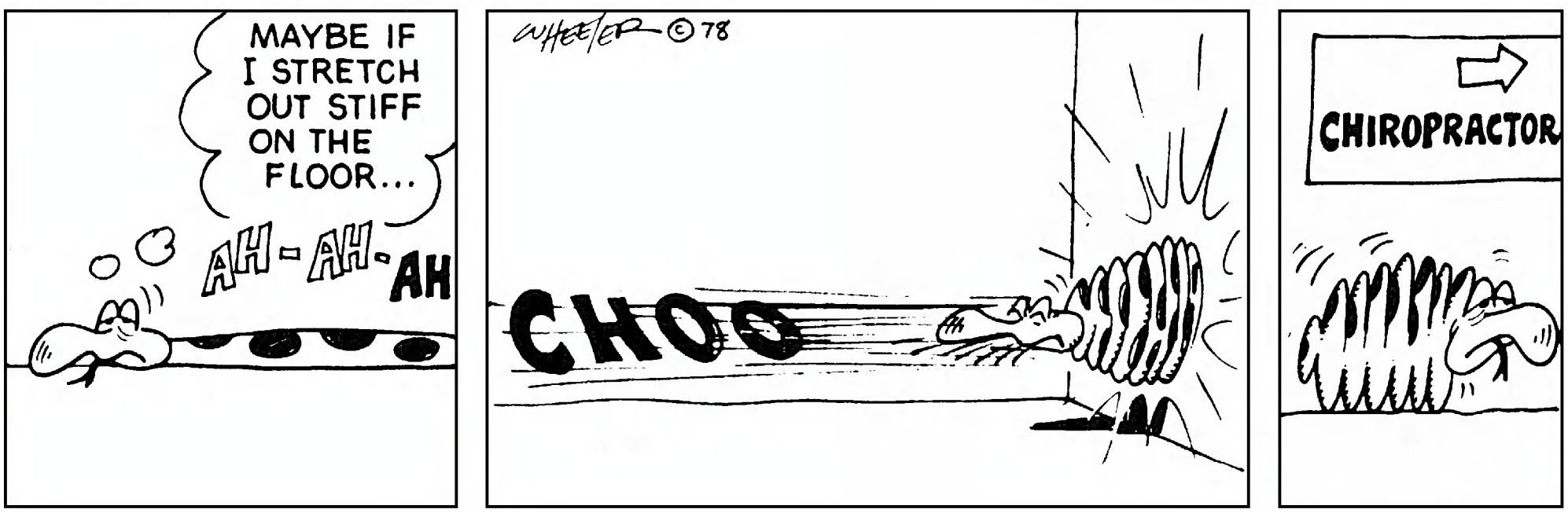
The Chicago Turtle Club

The monthly meetings of the Chicago Turtle Club are informal; questions, children and animals are welcome. Meetings normally take place at the North Park Village Nature Center, 5801 N. Pulaski, in Chicago. Parking is free. For more info call Lisa Koester, (773) 508-0034, or visit the CTC website: http://www.geocities.com/~chicagoturtle.

HERP OF THE MONTH

Each monthly meeting will showcase a different herp. CHS members are urged to bring one specimen of the "Herp of the Month" to be judged against the entries from other CHS members. Prizes will be awarded to the top three winners as follows: 1st place—6 raffle tickets at next meeting; 2nd place—4 raffle tickets at next meeting; 3rd place—2 raffle tickets at next meeting. The Herp of the Month category for November is skinks.

THE ADVENTURES OF SPOT



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